Notes on the Biology of Adult and Immature Amycterinae (Coleoptera, Curculionidae)

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Adults of the endemic Australian weevil subfamily Amycterinae feed primarily on monocotyledons but a few eat dicotyledons. The varied morphology of the adult mouthparts is shown to correspond to the texture of the food plant. Species which feed on wiry stems have stout, blunt mandibles and a pronounced 'gular roll'; at the opposite extreme, species which feed on the most tender lily leaves have thin-edged slicing mandibles and no gular roll, leaving the maxillae and prementum completely exposed.

Notes on the biology of the immature stages of ten genera of amycterines are reported. Oviposition is apparently in the soil. Larvae of one species feed on the tender new growth of *Xanthorrhoea* crowns; other species observed feed on underground stems, tubers and rhizomes, and possibly roots. Pupation takes place in the soil.

The function of the modified 8th sternite (the 'forceps') of male *Phalidura* is discussed.

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INTRODUCTION

The endemic Australian weevil subfamily Amycterinae includes an estimated 500 species. The weevils are favourites of collectors because of their unusual and often spectacular structural modifications, but their biology was almost unknown as recently as 1970 (Britton, 1970: 619). The few published references to biology concern mainly the weevils' hiding places and supposed food sources. Many of the food records, such as *Eucalyptus* bark (Ferguson, 1921: 29, 30) and dry, dead wood (Macleay, 1865: 201) are spurious. So little is known concerning the biologies of the species that even precise localities and dates of collection are worthwhile contributions.

Information is recorded herein concerning immature stages of ten genera of Amycterinae and the adult food of another five genera. In addition, the morphology of the adult mouthparts of amycterines is discussed as it relates to the texture of their food plants, and the morphology of the ovipositor is discussed as it relates to method of oviposition.

METHODS

E. C. Zimmerman, Curator of Weevils Emeritus, Commonwealth Scientific and Industrial Research Organization, Canberra, assisted with the identifications of the adults, and I have personally examined many of the types of Blackburn, Ferguson, Lea, Macleay, Pascoe, Sloane, and Waterhouse. No nomenclatural changes are made in this paper, because a comprehensive work including the Amycterinae is in preparation by E. C. Zimmerman. At his suggestion, all references to higher classification are omitted here because of his anticipated changes to the system. Genera are discussed using the nomenclature and taxonomic sequence found in the *Coleopterorum Catalogus* (Schenkling and Marshall, 1931).

Immature stages are being described in a separate publication by Brenda May, Department of Scientific and Industrial Research, Auckland, New Zealand.

Voucher specimens of adult and immature stages will be deposited in the Australian National Insect Collection, Canberra, and, where sufficient material exists, in the New Zealand Arthropod Collection, Auckland, and the Howden collection.

Biological observations were made over a period of nine years during four trips to Australia, totalling 16 months of field time. These trips were: (1) December 1974 to June 1975, in eastern Australia between Atherton, Queensland, and Canberra, Australian Capital Territory; July 1975, in southwestern Western Australia. (2) July and August 1978, Sydney, New South Wales; Canberra, Australian Capital Territory; across the Nullarbor Plain; and the Western Australian districts of South West, Murchison, Gascoyne, and Pilbara north to Point Samson. (3) August to November 1981, Sydney, New South Wales; Western Australian districts of South West and Murchison; Yorke Peninsula, South Australia. (4) July and August 1983, Sydney, New South Wales; Western Australian districts of South West and Murchison; Australian Capital Territory and New South Wales between Canberra and northwestern New South Wales and adjacent territory.

The Food and Mouthparts of Adult Amycterinae

Adults feed on a variety of plants, mostly monocotyledons, but also on some dicotyledons, namely legumes and myrtaceous plants. According to the growth form of these plants, amycterines feed at ground level (on *Arthropodium*, *Bulbine*, etc) to over a metre above ground (on *Acacia*, *Bossiaea*). Table 1 summarizes the observed and suspected food plants of adults and larvae. Note that the classification of these plant taxa apparently does not closely follow the classification of the weevils at the generic level. There is, however, a correlation between the **texture** of the plants and the weevil genera. If the plant taxa were rearranged according to the relative tenderness of the tissues consumed by the weevils and then compared to the type of mouthparts of the weevil, the correlation would be striking.

Table 1

Plant-Amycterinae Associations

Plant species	Location	Amycterine species and stage	adult	egg	larva	pupa
POACEAE						
Astrebla pectinata	Tibooburra, E to 85km W, NSW	*Cubicorrhynchus taurus*	X			
Cenchrus ciliaris	3km NW Pt Augusta, SA	*Cubicorrhynchus* sp.	X			
Enneapogon nigricans	Pt Augusta and 3km NW, SA	*Cubicorrhynchus* sp.	X		X[a]	
Eragrostis eriopoda	100km SE Tibooburra, NSW	*Cubicorrhynchus* sp.			X[a]	
	70-100km NW Tibooburra, NSW	*Cubicorrhynchus taurus*	X			
Eragrostis eriopoda?	Waka Hsd (90km W Tibooburra), NSW	*Cubicorrhynchus taurus*	X		X[a]	
	Warri Warri Gate and N, Qld	*Cubicorrhynchus taurus*	X		X[a]	
Nassella trichotoma	nr Yass, NSW	*Phalidura assimilis*	X		X	X
		Phalidura elongata	X			X
		Cubicorrhynchus sp.	X		X[a]	X
Stipa sp.	56km E Kimba, SA	*Cubicorrhynchus calcaratus*	X		X[a]	
	Damboring (N Ballidu), WA	*Cubicorrhynchus* sp.			X[a]	
Stipa nitida	91km NW Bourke, NSW	*Cubicorrhynchus* sp. nr *taurus*	X			X
	87km E Wilcannia, NSW	*Cubicorrhynchus* sp. nr *taurus*	X		X[a]	
	125km E Wilcannia, NSW	*Cubicorrhynchus* sp. nr *taurus*?	X		X[a]	
Triodia basedowii	1km S tip North West Cape, WA	*Notonophes auriger*	X		X[a]	
Unidentified grasses	nr Yass, NSW	*Acantholophus spinifer*	X			

TABLE 1 (concluded)

Plant species	Location	Amycterine species and stage	adult	egg	larva	pupa
POACEAE						
Unidentified grasses	Oodlawirra, SA	*Cubicorrhynchus* sp.	X		X[a]	
		Acantholophus planicollis	X		X[a]	
	Mt Horner, WA	*Cubicorrhynchus crenicollis*	X		X	X
	Onslow, WA	*Chriotyphus tibialis*	X		X[a]	
		Notonophes sp.	X			
	36km W Yalgoo, WA	Gen. indet.			X	
	Yellowdine, WA	*Acantholophus maximus*			X[a]	
	50km NW Yuna, WA	*Acantholophus maximus*	X			
CYPERACEAE						
Lepidosperma sp. nr *gracile*	55km S Marvel Loch, WA	*Talaurinus* sp.	X			
		Acantholophus transitus	X			
Lepidosperma sp. nr *viscidum*	80km S Marvel Loch, WA	*Acantholophus transitus*	X			
ECDEIOCOLEACEAE						
Ecdeiocolea monostachya	52km E Kalbarri, 42km NW Yuna, 65km S Wurarga, WA	*Acantholophus maximus*	X		X[a]	
RESTIONACEAE						
Lepidobolus preissianus	90 Mile Tank, WA	*Macramycterus draco*	X			
LILIACEAE						
Gen. indet.	Thomas River, WA	*Talaurinus echinops*	X			
Arthropodium capillipes	28km W Yalgoo, WA	*Dialeptopus echinatus*	X	X	X	
		Polycreta metrica	X			
	56km S Mullewa, WA	*Ennothus fallax*	X		X	
Bulbine alata	Tibooburra, Menindee, Bourke, Wilcannia, NSW	*Bubaris pubescens*	X		X	X
Dianella revoluta	Lake Bryde, Mt Madden, WA	*Mythites* sp. indet.	X		X	
	52km E Kalbarri, 20km N Northampton, 18km S Wurarga, WA	*Mythites basalis* var. *nodosus*	X		X	X
Stypandra imbricata	Mt Madden, WA	*Cucullothorax horridus*	X			
AMARYLLIDACEAE						
Doryanthes excelsa	Engadine, NSW	*Acantholophus marshami*	X			
XANTHORRHOEACEAE						
Lomandra sp.	Congo, NSW	*Talaurinus simillimus*	X		X	X
Lomandra longifolia	Clyde Mt, NSW	*Mythites granulatus*	X			
		Talaurinus rugifer	X			
	Atherton, Qld	*Talaurinus subvittatus*	X			
Xanthorrhoea spp.	Engadine, NSW	*Acantholophus marshami*	X		X[a]	
	Glenbrook, NSW	*Acantholophus marshami*			X[a]	
FABACEAE						
Acacia sp.	55km E Mullewa, WA	*Dialeptopus echinatus*	X			
	28km W Yalgoo, WA	*Dialeptopus echinatus*	X			
Bossiaea linophylla	30km W Pemberton, WA	*Acantholophus* sp. A nr *aureolus*	X			
Daviesia teretifolia	Cape Le Grand, WA	*Hyborrhinus prodigus*	X			
		Acantholophus sp. B nr *aureolus*	X			
Jacksonia foliosa	18km S Wurarga, WA	*Sclerorinus* sp.	X			
Jacksonia foliosa?	Hopetoun, WA	*Acantholophus* sp. B nr *aureolus*	X			
MYRTACEAE						
Melaleuca sp.	90 Mile Tank, WA	*Acantholophus* sp.	X			
Leptospermum sp.	Northcliffe, WA	Gen. indet.	X			

[a] Identification of larva questionable.

The mouthparts of adult amycterines exhibit a relatively wide range of form for one subfamily. The base of the oral cavity and the mandibles especially show modifications at the generic level. At one extreme, the mandibles of *Polycreta metrica* Pascoe (Figs 5, 6) have a thin, blade-like cutting edge, and the ventral surface of the rostrum is not modified at the base of the oral cavity. The leaves of *Arthropodium capillipes* on which *P. metrica* feeds are as tender as young onion leaves. At the other extreme, the mandibles of *Macramycterus draco* Macleay (Fig. 3) are massive and blunt-edged. The base of the oral cavity is grossly developed into a thick lip or 'gular roll' (Dohrn, 1872: 144) which extends forward 1mm or more to conceal the prementum. The leafless stems of *Lepidobolus preissianus*, on which this *Macramycterus* feeds, are extremely tough and wiry. However, the stout mandibles of *M. draco* do not prevent it from also feeding on tender plants such as ryegrass. The neat little slices of the unknown plant in Fig. 2 were regurgitated by the *M. draco* in Fig. 1.

It seems likely that the heavily reinforced base of the oral cavity provides structural strength for the operation of the mandibles. The thickest lip is associated with the toughest food plants; moderate modification consists of a moderate lip with a sinuous edge and is associated with leathery food plants; and so forth, until the extreme condition in which there is no apparent modification of the base of the oral cavity associated with the softest plants. Additional discussions of mouthparts in relation to texture of plants are found under particular species, especially *Talaurinus*, *Acantholophus* sp. nr. *hypoleucus* (Boheman), and *Mythites*.

Table 1 shows also that all the dicot records refer to adults only. It is possible that adults have a wider range of food plants and that immature stages are associated only with monocots. For example, *Dialeptopus echinatus* Lea in captivity fed and bred on the lily *Arthropodium capillipes* but was observed in the field on *Acacia* and other plants.

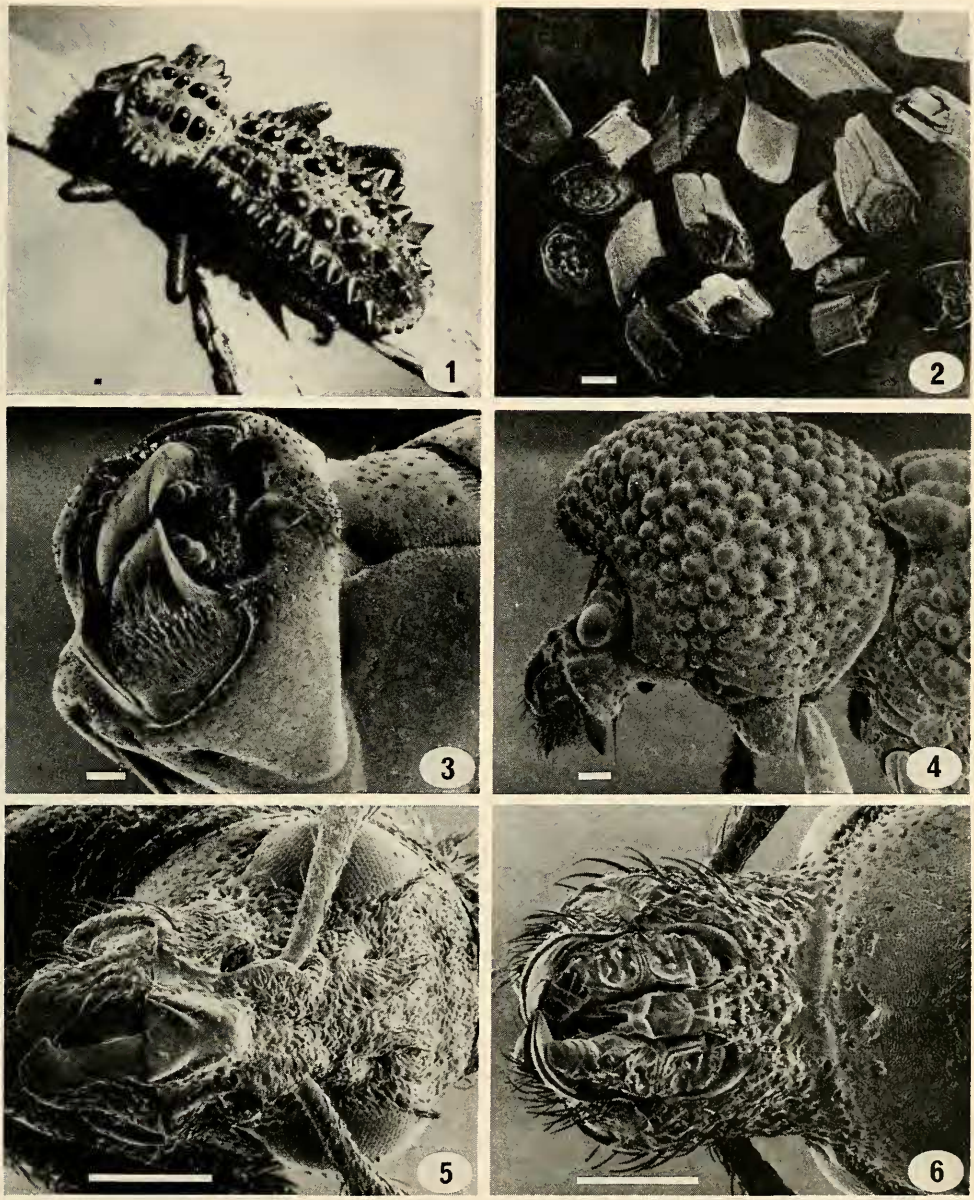
General Observations on the Life History of Amycterinae

Oviposition and morphology of the ovipositor

Oviposition apparently takes place in the soil, as the following evidence indicates. Numerous attempts to rear confined adults of many species resulted in eggs and a larva of *Dialeptopus echinatus*. The large, creamy yellow eggs were dropped on the surface of the soil, and after two weeks of extreme conditions, the eggs were dead. However, one egg had apparently been placed in the soil, and a larva was found in the container a month after the adults were confined. This suggests that dropping the eggs on the surface was a response to stress or infertile eggs and that placing the egg in the soil was the norm.

Newly eclosed larvae of *Bubaris pubescens* and *Mythites* spp. begin feeding on the exterior surface of the underground stem of their food plant and not from a position already within the stem which would be the case if the egg had been inserted into the plant tissue.

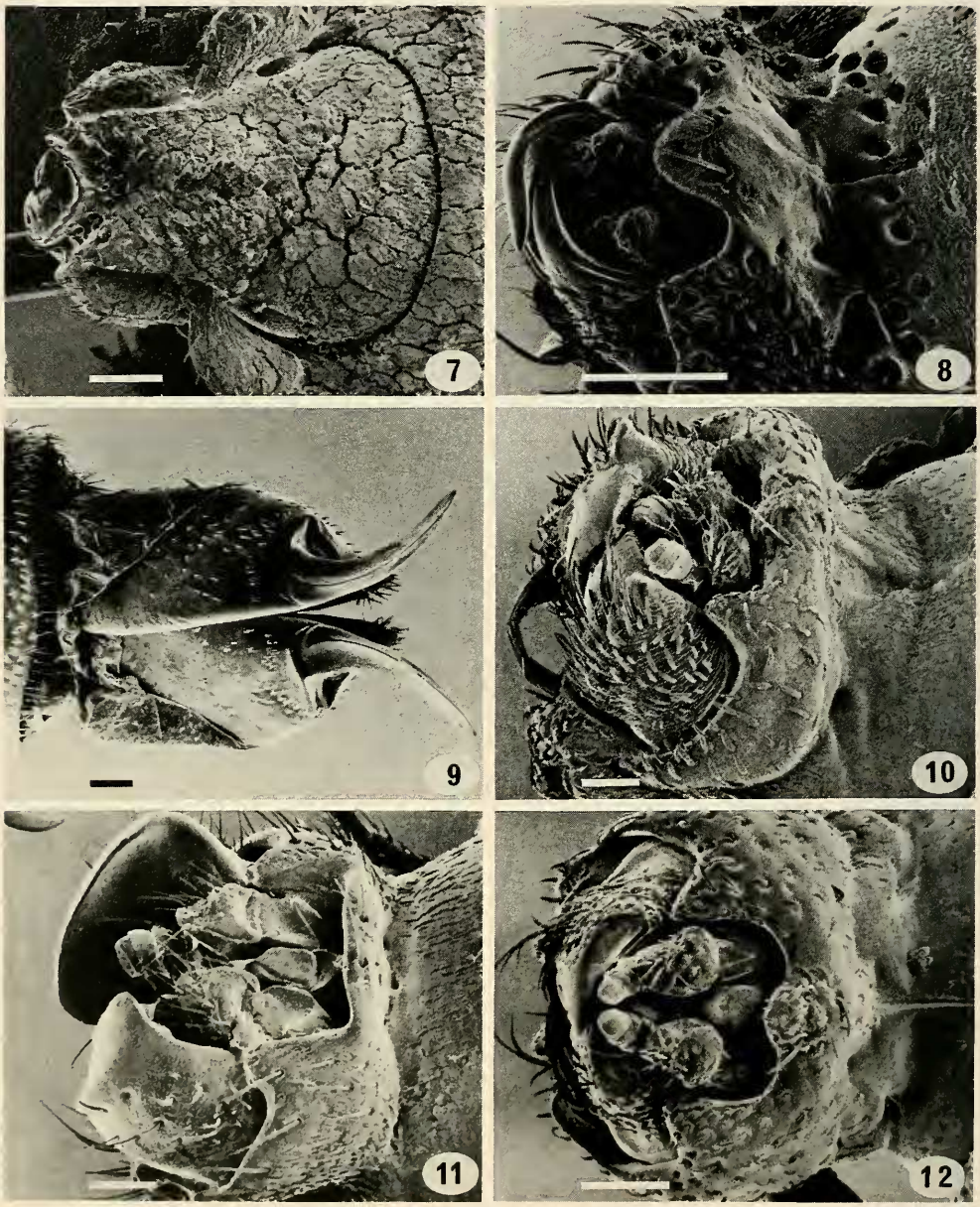
The morphology of the ovipositor also seems to be consistent with oviposition in the soil. In amycterines the stylus, near the apex of the coxite dorsally, has evolved into a free, heavily sclerotized, outwardly-directed blade (Fig. 9). In most species the blade is crescent-shaped, with or without a tooth on its dorsal edge, and ranges in shape from a paddle to a simple scoop (*Mythites*). This same type of free sclerite is found in the South African subfamily Hipporhininae and in at least some Tanyrhynchinae, but oviposition has not been observed in these groups either. An analagous, but not homologous, ovipositor is found in some North American Leptopiinae which are known to oviposit in the soil.



Figs 1-6. Figs 1-3. *Macramycterus draco* Macleay, male: 1) sunning on twig, 2) slices of plant regurgitated by specimen in Fig. 1, 3) oblique ventral view of mouthparts. Fig. 4 *Cucullothorax horridus* Ferguson, female, profile of head and prothorax. Figs 5,6. *Polycreta metrica* Pascoe, male, mouthparts: 5) anterior view; 6) ventral view. Scale line = 0.5mm.

Larval stage

With one exception (*Acantholophus marshami* (Kirby)?), all larvae found to date feed underground. Species associated with grasses (e.g., *Phalidura*, *Cubicorrhynchus*, etc.) feed on the subterranean crowns and there is no direct evidence of their feeding on roots.



Figs 7-12. Figs 7, 8. *Bubaris pubescens* Lea: 7) dorsal view head and rostrum of female with typical dirt encrustation, 8) oblique ventral view mouthparts of reared male. Fig. 9. *Macramycterus* sp., apex of female genitalia, dorsal view. Fig. 10. *Talaurinus subvittatus* Ferguson, male oblique ventral view of mouthparts. Fig. 11. *Acantholophus* sp. nr. *hypoleucus* (Boh.), female, oblique ventral view of mouthparts. Fig. 12. *Mythites basalis* var. *nodosus* Ferguson, female, ventral view of mouthparts. Scale line = 0.5mm.

Species that feed on Liliales feed on the subterranean stems and tubers or rhizomes, and again there is no direct evidence of their feeding on roots.

Pupal stage

Larvae pupate where they have fed or only a few centimetres away (*Cubicorrhynchus crenicollis* Waterhouse, *Bubaris pubescens* Lea), or they may travel some distance to pupate. On two occasions, *Acantholophus* sp. pupae were dug from the centre of a sand track a metre or more away from any vegetation. The presence of the pupae was indicated by a slight disturbance on the surface of the soil directly over the vertical cell.

Biological Observations by Species

Phalidura spp.

Male *Phalidura* are characterized by a pair of grotesque 'forceps' protruding from the abdomen. These 'forceps' of the vernacular are the highly modified male 8th sternite which is divided into a pair of massive, free, elongate sclerites up to half the length of the weevil, and which together strongly resemble a pair of forceps. The function of the forceps, '. . . so far as one can reasonably infer, is to grip the female right round the hinder end of her body . . .' (Gahan, 1918: cxxi). However, in repeated observations, copulating pairs of *P. elongata* Macleay and *P. grandis* Ferguson never used the forceps in this manner, and furthermore, it seems physically impossible. The apices of the forceps can only be moved apart by approximately 2mm; the minimum width of *Phalidura* females is much greater. The sides of the 7th sternite confine the forceps at the base and prevent greater lateral movement. The forceps extend into the abdomen by several millimetres and are prevented from being pulled out any farther by a connecting vertical internal disc which is approximately 3.5mm in diameter.

The copulatory posture observed in *P. elongata* and *P. grandis* is as follows. The abdomen of the male is extended to the maximum amount so that the massive, heavily sclerotized penultimate tergite is directed ventrally and slightly anteriorly; the last tergite is completely horizontal and anteriorly directed; the forceps are parallel to each other and likewise extend the maximum distance, their apices almost reaching the female's metasternum and presumably pressing upwards. This pressure may be the only function of the forceps. The forceps also bear species-specific arrangements of setae which suggests a recognition function (*see* Baker and Thompson, 1978).

Phalidura assimilis Ferguson and *P. elongata* Macleay

These species were reported by Barry Moore (1978: 138; and *in litt.*) breeding and feeding on *Nassella trichotoma* near Yass, New South Wales. The larva of *P. assimilis* is illustrated in Moore (1980: 13).

Phalidura grandis Ferguson

A short series was taken in Tibooburra, New South Wales, in August feeding in a small yard planted in Kikuyu and other grasses.

Talaurinus spp.

Two species of *Talaurinus* (*rugifer* and *subvittatus*) were observed feeding on *Lomandra longifolia*, and a third species of *Talaurinus* (*simillimus*) is associated with a *Lomandra* sp. The leaves of *L. longifolia* are very tough and the mouthparts of both species observed feeding on them are heavily reinforced with a conspicuous gular roll (Fig. 10). The other food plants listed below for *Talaurinus* spp. are likewise tough to very tough and the mouthparts of the weevils are similar to those in Fig. 10.

Talaurinus echinops (Pascoe)

One specimen was taken at Thomas River, Western Australia, in October in debris of a *Patersonia*-like plant.

Talaurinus molossus Pascoe (*Sclerorinus* in Schenkling and Marshall, 1931)

A series was taken at Newdegate, Western Australia, in July walking on bare ground at midday.

Talaurinus rugifer (Boisduval)

One male was observed at Clyde Mountain, New South Wales, in April feeding on a leaf of *Lomandra longifolia*.

Talaurinus simillimus (Macleay)

One adult, eight larvae, and one pupa were collected by Murray S. Upton at Congo, New South Wales, in March with *Lomandra* (B. May, *in litt.*).

Talaurinus subvittatus Ferguson

A short series was observed at Atherton, Queensland, in February feeding on *Lomandra longifolia*.

Talaurinus sp.

One male from Marvel Loch, Western Australia, in September was associated with *Lepidosperma*.

Molochtus gagates Pascoe

A series was taken 23km west of Yalgoo, Western Australia, in July under mulga logs and under bark of mulga logs on the ground.

Chriotyphus tibialis Ferguson

A series was taken at Onslow, Western Australia, in July in grass clumps growing in sand near the beach. One amycterine larva (genus?) was in the same grass.

Chriotyphus sp.

A series was taken at Coral Bay, Western Australia, August, in grass clumps growing in sand near the beach.

Sclerorinus spp.

A series was taken 18km south of Wurarga, Western Australia, in August at night after 2200 hours in matted stems of *Jacksonia foliosa* about 5-10cm above ground level.

Sclerorinus spp. were common on the Nullarbor Plain between Caiguna and Madura, Western Australia, in August under glasswort.

Macramycterus spp.

Macramycterus species appear to be strictly diurnal in their activities, including copulating (July and September) and sunning on a perch 45cm above ground (Fig. 1).

Macramycterus draco Macleay

A short series at 90 Mile Tank, Western Australia, in September displayed a typical feeding behaviour consisting of walking up to a stem of *Lepidobolus preissianus*, chewing off the stem near the ground and eating the stem. In captivity a weevil facing down on a

stem of *L. preissianus* was observed to cut the stem off beneath itself (about 5cm above the ground), to cling to the cut portion as it fell to the ground, and to continue feeding on the freshly cut end, consuming about 2.5cm in 5 minutes. Mouthparts of *Macramycterus* are discussed elsewhere in this paper (see p. 94).

Acantholophus spp.

The large genus *Acantholophus* is highly varied in its biology. There are many more nocturnal than diurnal observations. Perambulating larvae of *Acantholophus* are described below.

Acantholophus sp. A near *aureolus* (Boheman)

A large series was observed 30km west of Pemberton , Western Australia, between 1930 and 2200 hours in a light rain, feeding on *Bossiaea linophylla* and two other species of shrubs at 0.5 to 1.2mm above ground.

Acantholophus sp. B near *aureolus* (Boheman)

A series was taken at Cape Le Grand, Western Australia, in October on cool overcast days under very dense *Daviesia teretifolia*, well-camouflaged on the ground in the sparse debris of grey, dead leaves of the same size and colour as the weevils. All specimens regurgitated green matter, presumably *Daviesia* foliage.

One adult at Esperance, Western Australia, in October was walking at night, in a temperature near freezing, in the vicinity of *Daviesia*.

Two specimens were found at Hopetoun, Western Australia, in August on the ground under *Jacksonia* sp.

Acantholophus sp. nr *hypoleucus* (Boheman)

A short series at Arrowsmith River, Western Australia, July, was taken under dead grass trees; the mouthparts (Fig. 11) indicate food of moderate texture.

Acantholophus marshami (Kirby)

Described by Froggatt (1896: 77) as '. . . the common Amycterid about the neighbourhood of Sydney. Most of the members of this large genus live upon the grass, but this one climbs up the leaves of the grass-tree, and clinging round them gnaws pieces out.'

A colony of amycterines at Engadine (40km south of Sydney), New South Wales, has been monitored for several years by the G. A. Holloway family and is apparently this species. The Holloways report (*in litt.*) larvae present from early May to mid November. One male *A. marshami* (det. A. Howden) was taken 9 May on the crown of a *Xanthorrhoea* containing amycterine larvae (det. B. May). The larvae are always in the crown, a metre or more above ground, in head-up position in a column of chewed matter, and feed on the innermost tender white leaves. Some larvae were of buff colour instead of white on 1 November; several weeks later all larvae were absent from *Xanthorrhoea*. Observations are continuing.

The Holloways also report amycterine larvae from other species of grass trees and from Glenbrook in the Blue Mountains.

Although the ectophytic behaviour of these larvae appears to be anomalous among amycterines, it is possibly only an extension of feeding in ground-level crowns of plants.

Three males of *A. marshami* were taken at Engadine (same site as above) in August under leaf scales of a standing dead flower stalk of the Gymea lily, *Doryanthes excelsa*.

Acantholophus maximus (Macleay)

Single adults and series were taken at four sites between 52km east of Kalbarri and 65km south of Wurarga, Western Australia, in August in clumps of *Ecdeiocolea monostachya*. A single amycterine larva was excavated at two of the sites, each larva 7.5cm below the surface of the ground in the crown of a plant.

Acantholophus planicollis Waterhouse

One adult was taken at Oodlawirra, South Australia, in August; nearby grass yielded six amycterine larvae of unknown genus.

Acantholophus spinifer Macleay

Adults and larvae, according to Moore (1978: 138), are associated with grass near Yass, New South Wales.

Acantholophus transitus Macleay

A short series was taken 55-80km south of Marvel Loch, Western Australia, in clumps of *Lepidosperma* spp. near *gracile* and near *viscidum*; adults were also taken in the vicinity of Lake King and Newdegate in July.

Cubicorrhynchus spp.

All *Cubicorrhynchus* species collected to date have been associated with either native or introduced species of Poaceae except for occasional instances in which the weevils appeared to be hiding only. *Cubicorrhynchus* larvae taken from the crowns of grass plants often regurgitated green material, indicating they had fed on underground stems and not the roots. Adults are primarily nocturnal.

Cubicorrhynchus calcaratus Macleay

Adult fragments and a larva were taken 56km east of Kimba, South Australia, in August in a clump of *Stipa* sp.

Cubicorrhynchus crenicollis Waterhouse

A colony near Mt Horner, Western Australia, was located in an unidentified species of native grass growing in an isolated strip of relatively undisturbed coastal heath. On 14 July larvae and fragments of adults were excavated from clumps of the grass. On 9 September, seven larvae and 17 pupae (some with larval exuviae still attached) were excavated. Pupae were 10-50mm deep in the soil in cylindrical excavations approximately 7mm in diameter, at the outer edge of the root mass of the clump.

Three adults were reared from pupae collected 9 September, ecdysis occurring in 5, 34, and 52 days. The first two adults emerged from pupae which had remained on the surface of the soil in the rearing tin. The third pupa was located in a cell in the bottom of the rearing tin and was still white 11 days before its ecdysis was artificially accelerated by increasing the moisture and temperature in the tin. Thus it appears that the duration of the pupal period varies greatly, and pupae deeper in the soil might be expected to have a longer pupation because warm temperatures and superficial rains would not reach them.

The inferred life cycle is thus: larva — July to September, pupa — August to November, adult emergence — September to November and later.

Cubicorrhynchus taurus Blackburn and related species

Several species may be included in this unit of specimens distinguished by having the fore coxae contiguous and the hind tibia of the male nodose and produced into a conspicuous lobe on the inner edge medially. The range is throughout the northwest corner of New South Wales and adjacent Queensland and South Australia, specifically, Tibooburra, southeast to Wilcannia, southwest to Menindee, through Broken Hill and northwest to Frome Downs. Specimens west of the Flinders Ranges are a different species (*Cubicorrhynchus* sp. from Port Augusta). Eighteen adults from a granite outcropping at Tibooburra were smaller and less developed in secondary sexual characters than specimens from the clay or sandy areas and may be a different species.

Adults and a few larvae collected July through August were associated with a variety of grasses especially *Astrebla pectinata* (Mitchell grass) and *Eragrostis eriopoda* (woollybutt). Dissected females contained no eggs but an abundance of fat. A sample of both sexes from various localities contained green plant matter in the digestive tract although the grasses were only beginning to show green after recent rains.

Caged specimens fed on grass by climbing up the blade and while still facing up, ate the blade from the tip down, backing down as necessary. One female observed cut the top 2cm from a blade of grass and carried it back and forth, pausing to feed on it. Many pieces of cut grass accumulated on the soil of the cage. This weevil cut the grass blade not with a single cut, but with an up and down rasping motion not observed in other amycterines. The mandibles and reinforced base of the oral cavity of this species indicate the ability to cut very tough material.

Cubicorrhynchus sp. near *taurus* Blackburn

This species resembles *C. taurus*, but males lack the conspicuous lobe on the hind tibia; the range is central New South Wales from 87km east of Wilcannia to 68km west of Cobar and north to 91km northwest of Bourke. At the latter locality one pupa was found 8cm deep in the ground under *Stipa nitida*. Larvae (presumably of this species) were found at several sites in the crowns and root masses of *Stipa nitida*. Abundant *Eragrostis* in the area yielded no amycterine adults or immatures.

Cubicorrhynchus sp. from Port Augusta

This species is related to *C. taurus* by the contiguous fore coxae, but the hind tibia of the male is straight for the proximal two-thirds, then strongly curved forward, its inner edge bearing a conspicuous tooth or prong at the distal fifth. The species was taken in South Australia from Port Augusta southwest to 9km west of Iron Knob, and north of Port Augusta to Quorn on the west side of the Flinders Ranges. Adults were taken in late July and late August in clumps of *Cenchrus ciliaris*, *Enneapogon nigricans*, and *Stipa nodosa*; larvae were taken in late July in *Enneapogon nigricans* and *Stipa nodosa*.

Notonophes auriger Ferguson

Adults were taken at Onslow, Western Australia, in July in debris washed around the base of grass; adult carcasses were found at the North West Cape in late July near a larva 3-5cm deep in soil under a tussock of *Triodia basedowii* (spinifex).

Notonophes gascoynensis Baker (1972: 123)

Adults at Carnarvon, Western Australia, in August were sheltering under *Salicornia australis* (samphire); the weevils are similar in colour and form to the debris under the plants.

Hyborrhinus Marshall (1946: 94) (= *Hyborrhynchus* Macleay in Shenkling and Marshall, 1931)

Hyborrhinus prodigus (Macleay) was taken at Cape Le Grand, Western Australia, in October, in debris under *Daviesia teretifolia*.

Mythites spp.

Two Western Australian species of *Mythites* (*basalis* var. *nodosus* Ferguson and sp. indet.) are associated only with *Dianella revoluta*, spreading flax-lily. The plant is discussed here because of its importance to *Mythites* and other amycterines. Old leaves of the plant remain stiff and upright, and old clumps of *Dianella* can be a metre or more wide, retaining thick layers of their own litter or windswept debris of *Eucalyptus* leaves, etc. Occasionally adults of other amycterines are found in the shelter of *Dianella revoluta* clumps, e.g., *Acantholophus* sp., *Acantholophus maximus*, *Acherres mamillatus* Pascoe, *Cubicorrhynchus bohemani* (Boheman), *Dialeptopus echinatus*, *Macramycterus* sp., and *Notonophes cichlodes* (Pascoe). However, all larvae excavated from *D. revoluta* are *Mythites* (B. May, *in litt.*).

Mythites adults usually feed by cutting out portions of the leaf margin, but caged beetles cut off the flower stalk of one *D. revoluta* at 9cm above ground. Mouthparts of *M. basalis* var. *nodosus* (Fig. 12) indicate a food plant of moderate texture.

Mythites basalis var. *nodosus* Ferguson

This species was observed and collected in a semicircle around Geraldton from north of Northampton to the Kalbarri turnoff, east to Wurarga, southeast to 55km east of Mullewa, south of Mullewa and west to Arrowsmith. Larvae were found 12 July to 10 September, pupae 7 September, adults 7 August through September. In the earliest observation, newly eclosed larvae 5-8cm below ground level had eaten into the underground *Dianella* stem from without; in addition, one large larva was found in a rhizome. In an August examination of a heavily infested *Dianella* clump, the rhizomes were found to be extensively excavated by larvae. Two pupae were found 2.5cm deep in the soil of a *D. revoluta* clump, one in a vertical cylindrical hole.

Mythites sp. indet.

Adults and larvae were taken at Lake Grace, Lake Bryde, and Mt Madden in southwestern Western Australia, on four occasions between 22 September and 13 October in clumps of *Dianella revoluta*. Some larvae were just below the surface of the soil above the roots and rhizomes. Other larvae had burrowed into the rhizomes and were feeding in cavities they had excavated from the exterior. Adults were found in all clumps of *Dianella* containing larvae.

Mythites granulatus Lea

One female at Clyde Mountain, New South Wales, on the morning of 8 April was observed feeding on *Lomandra longifolia*.

Bubaris pubescens Lea

Adults and immature stages were found in August in the large area of red sand plains of northwestern New South Wales ranging from Menindee north to Tibooburra and the Queensland border, southeast of Tibooburra towards Wanaaring, from Wilcannia to 87km east of Wilcannia and north to 35km north of Bourke.

Adults and larvae feed on the leek lily, *Bulbine alata*, a small lily with an onion-like cluster of tender leaves and a short flower stalk. The roots do not bear tubers, nor is there a swollen base or bulb.

The following synopsis is based on hundreds of observations at the many localities listed above. Newly eclosed larvae eat directly into the base of the underground portion of the stem, immediately above the roots, usually 4-25mm below the surface of the soil. Older larvae feed externally on the underground stem while encased in a hollowed concretion of sand grains which adheres to the stem. When injured, the lily stem bleeds a slightly viscous sap and this seems to cause or contribute to the accretion of the sand. Usually there is only one larva per plant; infestation by two or three larvae per plant is uncommon and when it occurs involves only small larvae. By the time larvae leave a plant, the plant is usually in seed and (1) showing no obvious above-ground evidence of distress (infrequently), or, (2) at least the outer leaves are dead and pinkish in colour (commonly), or, (3) the plant is completely dead (infrequently). Older larvae may travel underground to feed or to pupate; large larvae are sometimes seen feeding on very small, previously untouched lilies. Pupae and prepupae are found in an earthen cell as far as 2.5cm from the host plant, but are usually directly beneath the plant and 0.6-15.0cm below the surface of the soil. Pupal cells are approximately 15-20mm long and 5-6mm wide. No freshly emerged adults were found, but a pupa collected 24 August was reared to adult in 21 days.

Since *Bulbine alata* responds very quickly to rain, local showers can have a strong influence on the availability of food for larvae. By waiting under bushes where the *Bulbine* seedlings will first appear, adults can oviposit as soon as suitable lilies are available. As with other species living in arid and semi-arid country with irregular rains, the life cycle of *Bubaris pubescens* is probably influenced more by precipitation than by the calendar.

The naturalized onion weed, *Asphodelus fistulosus*, is similar in plant form to *Bulbine alata*, and the two species may grow intermingled in one area. At Menindee, a large number of both plants in equal numbers was examined; only the *Bulbine* was infested with amycterine larvae. However, a large *Bubaris* larva confined for five days with only an *Asphodelus* plant for food ate a typical spherical hole 3mm in diameter in the base of the underground stem.

Adults of *B. pubescens* have a dense coat of short, wiry, curled 'setae' distributed everywhere except around the apex of the rostrum and ventral surface of the head (Figs 7, 8). These setae may produce a gummy exudate. The prothorax has closely spaced cylindrical tubercles 0.3-0.5mm high, and the elytra have similar but fewer tubercles. The result of this ornamentation is that the weevil becomes encrusted with particles of soil firmly wedged and glued in place (Fig. 7). This crust is very good camouflage.

Dialeptopus spp.

Dialeptopus have long, slender legs and many of the Western Australian species can be seen running quickly and conspicuously over the ground in the daylight hours of the winter months.

Dialeptopus echinatus Lea

Adults are common east and southeast of Geraldton, Western Australia, in the winter months. Copulating pairs were taken on *Acacia* at several localities and on a 'sedge.' Caged beetles fed only on *Arthropodium capillipes* when given a sample of vegetation from the Yalgoo area which included *Dianella revoluta* and *Acacia. Arthropodium capillipes* is a delicate lily with fleshy leaves and a tall flower spike appearing in the early spring. The roots are fibrous and many terminate in small tubers. Leaves were eaten by the weevils from the margin towards the centre of the leaf. One pair of weevils caged for a month produced seven eggs, one of which eclosed, and the larva during that month excavated almost one-quarter of a tuber on the end of a root.

Dialeptopus plantaris Pascoe

Two very active specimens were taken 82km north of Carnarvon, Western Australia, in July on spinifex.

Cucullothorax horridus Ferguson

One female (Fig. 4) was taken at Mt Madden, Western Australia, in July on *Stypandra imbricata*; additional specimens were taken at 90 Mile Tank (September) and carcasses of specimens at Marvel Loch.

Sosytelus lobatus Pascoe

One specimen was taken near Sydney, New South Wales, in August walking during the day.

Ennothus fallax Pascoe — *Polycreta metrica* Pascoe complex

These two monotypic Western Australian taxa are probably congeneric, *Ennothus* being the senior name. Specimens from 56km southwest of Mullewa and from Tunney are referable to *Ennothus fallax*. Specimens from 28-29km west of Yalgoo and 55km south of Marvel Loch are referable to *Polycreta metrica*. This distribution suggests the range of *Polycreta metrica* is in an area of lower rainfall, i.e., outside the wheat belt and with less than 25cm of rain annually, where *Ennothus fallax* occurs in slightly higher rainfall areas.

These small, active amycterines, 5.0-8.6mm, are reminiscent of *Dialeptopus* with their long legs and distinctly spider-like appearance.

All specimens were associated exclusively with *Arthropodium capillipes*. Usually the weevils were concealed deep in the rosette of leaves at the base of the plant or under debris very close to a lily. Weevils were observed feeding on leaves of the lily, once during the day (*P. metrica*) and once at night (*E. fallax*). In captivity the weevils ate only *Arthropodium capillipes*. Mouthparts of *P. metrica* are shown in Figs 5 and 6.

At the Mullewa site in July, three larvae were found 8-10cm deep in the soil around an *Arthropodium* plant on which an *E. fallax* had been feeding. All tubers from the excavated plant were collected and examined under a microscope. One shell of a tuber contained parts of an adult male *E. fallax*; other empty tubers contained pieces of head capsules and an almost complete larval exuvia.

No immature stages were found in September, but adults were much more numerous then.

Conclusions

Biological observations have helped to interpret some of the structural modifications of adult amycterines. The varied morphology of the mouthparts relates to the texture of the food plant. The unusual stylus of the ovipositor probably relates to oviposition in the soil.

In addition, two findings indicate that amycterines are a relatively old group, namely, placing the eggs in the soil (which is plesiomorphous in Curculionidae) and larvae feeding on monocots (monocots being an older group of angiosperms than dicots).

The inferred life cycle of the species observed south of the Tropic of Capricorn is as follows. Eggs are laid in the soil in the winter. Larvae of the majority of species feed on underground stems (*Bubaris*, *Mythites*), on the crown of grasses (*Cubicorrhynchus*), on tubers (*Dialeptopus*, *Ennothus*), and on rhizomes (*Mythites*); larvae of one species feed on aerial crowns of grass trees (*Acantholophus*?). Larval development is completed in the winter or early spring. Pupation occurs in the soil and the duration of the pupal stage in

arid and semi-arid areas may be influenced more by moisture and temperature than by the calendar.

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